

AMENDMENTS TO THE SPECIFICATION

Please amend the paragraph beginning at page 13, line 22, as follows:

An exemplary power supply ~~[[380]]~~ (not shown) for the process provides up to 10 volts at an average current of 30 amps and a peak current of 60 amps. The power supply requirements will change depending on the size of the area to be electroplated on the workpiece. The current density may be 100-300 mA/cm². A particularly useful current density is 150-220 mA/cm². The waveform may be a pulse with a 10-50% duty cycle at 50-1000 Hz, as well as a DC. A particularly useful waveform is a DC and a pulse with a 50% duty cycle at 100 Hz. The power supply and other components of the tool are controlled by a controller ~~[[400]]~~ (not shown).

Please amend the paragraph beginning at page 13, line 30, through page 14, line 2, as follows:

An exemplary mode of electroplating is to rotate the workpiece in a plating chamber at a speed of 20-200 revolutions per minute with the plating bath flowing against the workpiece at a flow rate of 1-10 gallons per minute. For a 150~200 mm-diameter wafer, the most preferred rotation speed is 20-60 revolutions per minute. For a 150~200-mm diameter wafer, the most preferred flow rate is 4-6 gallons per minute.

Please amend the paragraph beginning at page 14, line 25, as follows:

In FIGURE 4, copper layer 34 has been electroplated on top of ~~conductive layer~~ second thin metal film 30 within opening 33 by employing the high rate electroplating process described above. This copper layer 34 is frequently referred to as a stud. Copper layer 34 is then covered by solder layer 36, which is also deposited by electroplating.

AMENDMENTS TO THE CLAIMS

1-19. (Canceled)

20. (Currently amended) A process for electroplating copper on a microelectronic workpiece in a through-mask plating application at a rate of at least 2 $\mu\text{m}/\text{min}$, said process comprising:

(a) providing a plating bath comprising:

- (1) ~~50-85 g/L of~~ Cu^{2+} ;
- (2) ~~50-100 g/L of~~ H_2SO_4 ;
- (3) ~~30-150 ppm of~~ Cl^- ;
- (4) a brightener;
- (5) a wetting agent; and
- (6) water;

(b) providing a microelectronic workpiece having one or more through-mask openings with a conductive layer at the bottom of said opening;

(c) contacting said conductive layer with said plating bath;

(d) providing electroplating power between said conductive layer and an anode disposed in electrical contact with said bath; and

(e) depositing copper onto said conductive layer at a rate of at least 2 $\mu\text{m}/\text{min}$.

21. (Original) The process of Claim 20, wherein the current density of said electroplating power is 100-300 mA/cm^2 .

22. (Original) The process of Claim 21, wherein the current density of said electroplating power is 150-220 mA/cm^2 .

23. (Original) The process of Claim 20, wherein the waveform of said electroplating power is a DC and a pulse with a 10-50% duty cycle at 50-1000 Hz.

24. (Original) The process of Claim 20, wherein said workpiece is rotated at a speed of 20-200 revolutions per minute and wherein said bath flows against said workpiece at a flow rate of 1-10 gallons per minute.

25. (Original) The process of Claim 20, wherein said bath has a temperature of 25-35°C.

26. (Original) The process of Claim 20, wherein the depositing step further comprising depositing copper to form a deposited feature having a smooth surface morphology.

27. (Original) The process of Claim 20, wherein the depositing step further comprising depositing copper to form a deposited feature that has a substantially flat surface.

28. (Original) The process of Claim 20, wherein the depositing step further comprising depositing copper to form a deposited feature that has a thickness variation of less than 10%.

29. (Currently amended) A process for electroplating copper on a microelectronic workpiece in a through-mask plating application at a rate of at least 2 $\mu\text{m}/\text{min}$, said process comprising:

(a) providing a plating bath comprising:

- (1) ~~50-85 g/L of~~ Cu^{2+} ;
- (2) ~~50-100 g/L of~~ H_2SO_4 ;
- (3) ~~30-150 ppm of~~ Cl^- ;

- (4) a brightener;
 - (5) a wetting agent;
 - (6) a leveler; and
 - (7) water;
- (b) providing a microelectronic workpiece having one or more through-mask openings with a conductive layer at the bottom of said opening;
- (c) contacting said conductive layer with said plating bath;
- (d) providing electroplating power between said conductive layer and an anode disposed in electrical contact with said bath; and
- (e) depositing copper onto said conductive layer at a rate of at least 2 $\mu\text{m}/\text{min}$.
30. (Original) The process of Claim 29 wherein the current density of said electroplating power is 100-300 mA/cm^2 .
31. (Original) The process of Claim 30 wherein the current density of said electroplating power is 150-220 mA/cm^2 .
32. (Original) The process of Claim 29 wherein the waveform of said electroplating power is a DC and a pulse with a 10-50% duty cycle at 50-1000 Hz.
33. (Original) The process of Claim 29 wherein said workpiece is rotated at a speed of 20-200 revolutions per minute and wherein said bath flows against said workpiece at a flow rate of 1-10 gallons per minute.
34. (Original) The process of Claim 29 wherein said bath has a temperature of 25-35°C.

35. (Original) The process of Claim 30, wherein the depositing step further comprising depositing copper to form a deposited feature having a smooth surface morphology.

36. (Original) The process of Claim 30, wherein the depositing step further comprising depositing copper to form a deposited feature that has a substantially flat surface.

37. (Original) The process of Claim 30, wherein the depositing step further comprising depositing copper to form a deposited feature that has a thickness variation of less than 10%.

38-43. (Canceled)

44. (New) A process for electroplating copper on a microelectronic workpiece in a through-mask plating application at a rate in the range of about 4 $\mu\text{m}/\text{min}$ to about 6 $\mu\text{m}/\text{min}$, said process comprising:

- (a) providing a plating bath comprising:
 - (1) Cu^{2+} ;
 - (2) H_2SO_4 ;
 - (3) Cl^- ;
 - (4) a brightener;
 - (5) a wetting agent; and
 - (6) water;
- (b) providing a microelectronic workpiece having one or more through-mask openings with a conductive layer at the bottom of said opening;
- (c) contacting said conductive layer with said plating bath;
- (d) providing electroplating power between said conductive layer and an anode disposed in electrical contact with said bath; and

(e) depositing copper onto said conductive layer at a rate in the range of about 4 $\mu\text{m}/\text{min}$ to about 6 $\mu\text{m}/\text{min}$.

45. (New) A process for electroplating copper on a microelectronic workpiece in a through-mask plating application at a rate in the range of about 4 $\mu\text{m}/\text{min}$ to about 6 $\mu\text{m}/\text{min}$, said process comprising:

(a) providing a plating bath comprising:

- (1) Cu^{2+} ;
- (2) H_2SO_4 ;
- (3) Cl^- ;
- (4) a brightener;
- (5) a wetting agent;
- (6) a leveler; and
- (7) water;

(b) providing a microelectronic workpiece having one or more through-mask openings with a conductive layer at the bottom of said opening;

(c) contacting said conductive layer with said plating bath;

(d) providing electroplating power between said conductive layer and an anode disposed in electrical contact with said bath; and

(e) depositing copper onto said conductive layer at a rate in the range of about 4 $\mu\text{m}/\text{min}$ to about 6 $\mu\text{m}/\text{min}$.